

AEROSOLS RADIOACTIVITY IN THE BRATISLAVA ATMOSPHERE

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1. Introduction

Radionuclides in the atmosphere come from various sources. Long-term monitoring of radioactivity of atmosphere allows to obtain useful information about radiation in the environment due to natural and man-made radionuclides and enables evaluation of their impact on peoples. Cosmogenic radionuclides present in ground level air enabled also study of dynamics of exchange and transport processes between various layers of atmosphere. Cosmogenic ^7Be is very suitable radionuclide to such investigation. It is produced by the interactions of cosmic radiation with the high levels of atmosphere by spallation of oxygen and nitrogen. This reaction produced BeO and $\text{Be}(\text{OH})_2$ which diffuse through atmosphere until they attach to an atmospheric aerosols. There are transported from stratosphere and upper troposphere to the ground-level air by exchange processes between air masses. Activity produced in stratosphere has residence time about a year and is transferred in troposphere, where the residence time is about six weeks. Transfer to earth's surface is largely accomplished by gravitational settling and precipitation processes. Concentration of cosmogenic ^7Be may significantly vary with altitude, also with latitude not only because of location of production, but because of atmospheric mixing process and half-life. ^7Be is relatively short-lived ($T_{1/2} = 53.3$ d) and emits 477.6 keV gamma rays with relative intensity 10.3 %. Variation in annual mean ^7Be concentration in long term monitoring is attributed mainly to changes in the atmospheric production rate, while seasonal summer increasing ^7Be concentration is considered to be due to strong stratosphere to troposphere exchanges. The flux of primary galactic cosmic rays that attack on the Earth's atmosphere is affected by the solar activity. Because ^7Be is purely outdoor origin, it is also suitable as a tracer in experiments examining the ingress of aerosols into buildings.

From natural radionuclides is interesting long lived ^{210}Pb ($T_{1/2} = 22.3$ y) - progeny of the primordial ^{238}U - ^{226}Ra -decay chain, which emits 46.5 keV gamma rays with relative intensity 4 %. In opposite to ^7Be , it is mainly produced in the atmosphere near ground level by the decay of rare gas ^{222}Rn , which emanate from soil. After decay of radon, the ^{210}Pb attach on the aerosols and their fate will become fate of the carrier aerosols. Also ^{210}Pb as well as ^7Be is very suitable for studying of the environmental processes such a aerosols transport and residence times in the troposphere, aerosols deposition velocities, and aerosols trapping above the ground vegetation. Informations about ^{210}Pb concentration is also important from radiohygienical point of view, because of its long half-life can contribute to radiation dose to man.

2. Experimental

2.1 Sampling

Radioactivity of atmospheric aerosols was typically monitored two times weekly in locality Mlynská dolina in Bratislava. Collection period was obviously about 3-4 days at air flow rate about $70 \text{ m}^3\text{h}^{-1}$. Aerosols were collected on nitrocellulose membrane filters (PRAGOPOR 4) with area 255 cm^2 and pore size $0.85 \mu\text{m}$.



2.2 Measurement

The aerosols filters were measured in low-level background shield [1] using the Ortec HPGe detector with Be window (FWHM at 122 keV 1 keV, peak efficiency at 46.5 keV about 15 %).

Results and discussion

In our laboratory we measured temporal variation of ^7Be concentration in the atmosphere in period 1977 –1994 years [2] (Fig.1). The aerosols were collected through every month at Hydrometeorological Institute in Bratislava – Koliba, latitude $48^\circ 10'$ and altitude 286 m above sea level.

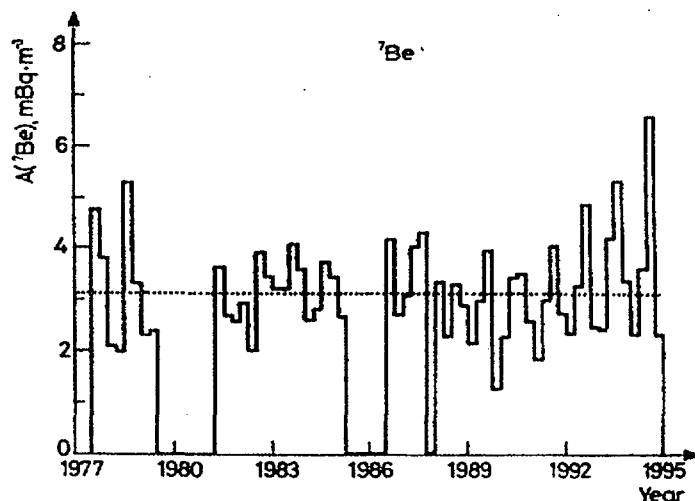


Fig. 1. Quarterly mean ^7Be concentration during the investigated period

Since end of year 2000 we have started to continue monitoring radioactivity of atmosphere aerosols in new locality in Bratislava -Mlynská dolina. Beside ^7Be we measured also ^{210}Pb radionuclide aerosols concentration. Results until September 15. are on Fig. 2 and 3.

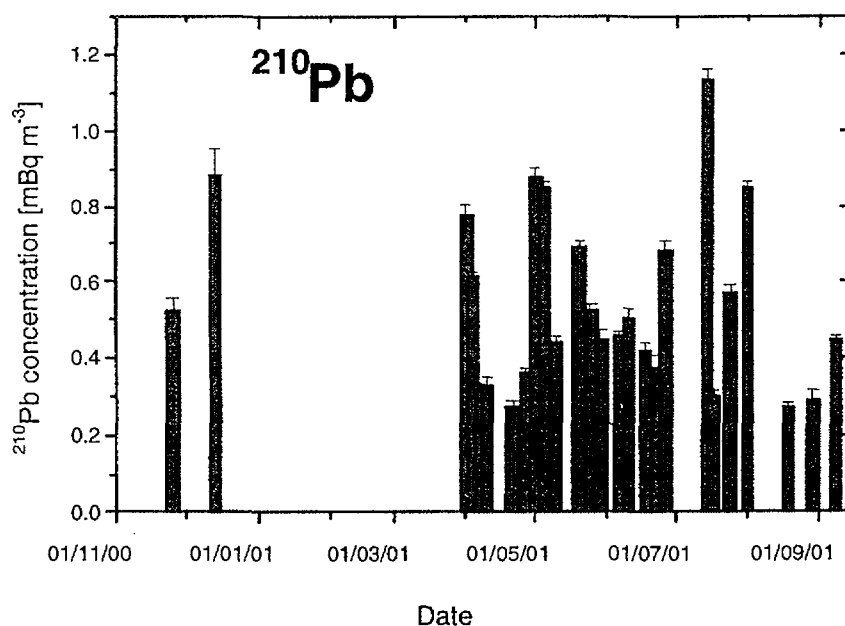


Fig 2. Temporal variation of ^{210}Pb concentration in aerosols

For measured values ^7Be concentrations are considered corrections for decay radionuclide during the time of filters collection, time between end of collection and measurement and decay during the time of measurement.

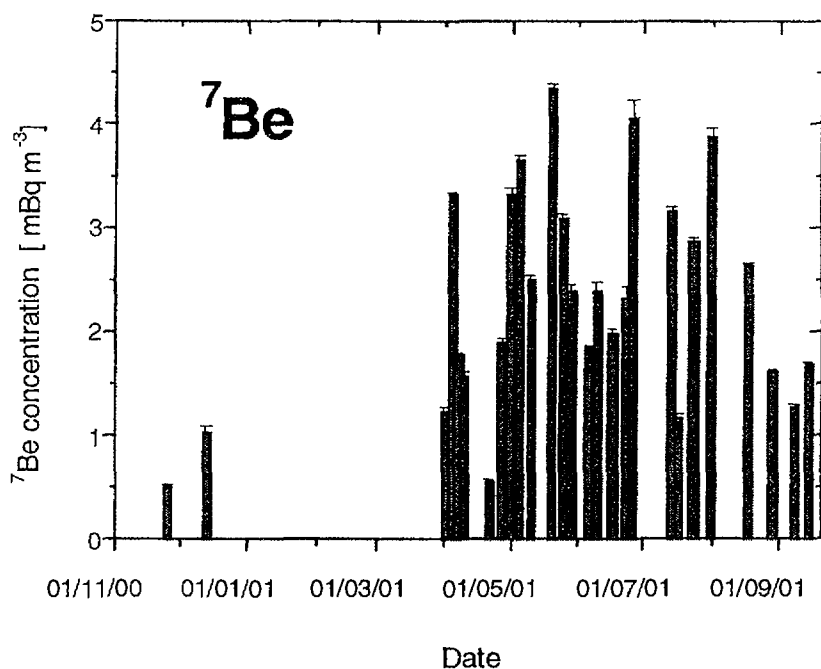


Fig. 3 Temporal variation of ^7Be concentration in the aerosols

Obtained results for ^7Be concentrations in aerosols shows seasonal summer maximum, but for ^{210}Pb concentration in aerosols the seasonal variations are not evident. The temporal variations of this radionuclide which is originated in ground-level atmosphere are more sensitive on meteorological factors and can be also influenced by the industrial activity. For better understanding is needed long term monitoring.

References

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- [2] L. Ďurana, M. Chudý, J. Masarik, *J. Radioanal. Nucl. Chem.* 207 (1996) 345-356